EXCESSIVE GESTATIONAL WEIGHT GAIN, FOOD INSECURITY AND ITS ASSOCIATED FACTORS AMONG PREGNANT WOMEN IN ANTENATAL CLINIC, HOSPITAL UNIVERSITI SAINS MALAYSIA

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BMI	:	Body Mass Index
HUSM	:	Hospital Universiti Sains Malaysia
OR	:	Odd ratio
SD	:	Standard deviation
CI	:	Confidence interval
df	:	Degree of freedom
GWG	:	Gestational weight gain

LIST OF SYMBOLS

>	More than
<	Less than
=	Equal to
≥	More than and equal to
≤	Less than and equal to
α	Alpha (Type I error)
%	Percentage
Δ	Precision
n	Number of sample
μ	Ratio of control to expected sample
σ	Standard deviation
δ	a difference in population means
P_0	Proportion of control sample
P_1	Proportion of expected sample
P	Expected proportion of the sample (in single proportion sample size) with the characteristic of interest
χ^2	Chi-square
Z_α	Z value based on 95% Confidence interval or normal deviates that reflects Type I error

ABSTRAK

PERTAMBAHAN BERAT BERLEBIHAN SEWAKTU KEHAMILAN, KETIDAK JAMINAN DAPATAN MAKANAN DAN FAKTOR – FAKTOR YANG BERKAITAN DENGANNYA DALAM KALANGAN IBU – IBU HAMIL DI KLINIK IBU MENGANDUNG HOSPITAL UNIVERSITI SAINS MALAYSIA

Nutrisi semasa jangkamasa kehamilan adalah penting kerana zat – zat makanan yang mencukupi diperlukan semasa pertumbuhan janin dan mengurangkan kebarangkalian penyakit – penyakit semasa dewasa nanti. Oleh itu, ketidakjaminan dapatan makanan adalah masalah kesihatan awam yang mempengaruhi kesihatan ibu, anak dan semasa dewasa nanti. Kajian ini telah dijalankan untuk mengenalpasti prevalens ketidakjaminan dapatan makanan dalam kalangan ibu -ibu hamil yang hadir ke klinik antenatal, Hospital Universiti Sains Malaysia, Kota Bharu. Kajian ini turut mengenalpasti perkaitan di antara ketidakjaminan dapatan makanan dan pertambahan berat sewaktu kehamilan. Kajian hirisan lintang ini menggunakan Instrumen Ketidakjaminan dapatan makanan dan Kelaparan Radimer/Cornell sebagai bahan mengkaji status ketidakjaminan dapatan makanan. Sejumlah 235 ibu - ibu telah terlibat di dalam kajian ini. Prevalens ketidakjaminan dapatan makanan di kalangan mereka ialah 41.3%; yang merangkumi tiga tahap keterukan, 32.3% mengalami ketidakjaminan dapatan makanan isirumah, 0.9% mengalami ketidakjaminan dapatan makanan individu dan 8.1% mengalami kelaparan anak. Min dan sisihan piawai pertambahan berat sewaktu kehamilan adalah 8.8 (5.05) kg. Kajian ini mendapati

ketidakjaminan dapatan makanan berkait secara signifikan ($\chi 2$= 10.98, p= 0.004) dengan pertambahan berat sewaktu kehamilan. Regresi Logistik Berganda, dengan pertambahan berat badan sewaktu kehamilan berlebihan sebagai hasil, telah menunjukkan ibu hamil yang mengalami ketidakjaminan dapatan makanan mempunyai 4.8 kali (adjOR 4.80, 95% CI: 1.94, 11.86; p=0.001) lebih cenderung untuk berlebihan berat badan sewaktu kehamilan. Berlebihan berat badan dan obes sewaktu sebelum mengandung adalah 6.17 kali (adjOR 6.17, 95%CI:2.70, 14.09; p<0.001) lebih cenderung untuk mendapatkan pertambahan berat badan sewaktu kehamilan yang lebih tinggi berbanding dengan wanita yang mempunyai normal sebelum mengandung. Kajian ini mendapati terdapat perkaitan yang signifikan di antara ketidakjaminan dapatan makanan dengan indeks jisim tubuh yang tinggi dan juga pertambahan berat sewaktu kehamilan di klinik antenatal, Hospital Universiti Sains Malaysia, Kota Bharu. Maka, terdapatlah keperluan untuk memastikan makanan dan zat – zat makanan di kalangan ibu – ibu hamil.

Kata kunci: ketidakjaminan dapatan makanan, ibu hamil, pertambahan berat sewaktu kehamilan, indeks jisim tubuh.

ABSTRACT

EXCESSIVE GESTATIONAL WEIGHT GAIN, FOOD INSECURITY AND ITS ASSOCIATED FACTORS AMONG PREGNANT WOMEN IN ANTENATAL CLINIC, HOSPITAL UNIVERSITI SAINS MALAYSIA

Nutrition during the pregnancy period is important as adequate nutrients are necessary for foetal development and prevention of future adult disease development, thus food insecurity is a public health problem that affect maternal, child and later adult health. The objective of this study was to identify the prevalence of household food insecurity among pregnant women who attended antenatal clinic, Hospital Universiti Sains Malaysia, Kota Bharu and also to determine the association between food insecurity and gestational weight gain. This cross sectional study used the Radimer/Cornell Hunger and Food Insecurity Instrument as an assessment tool for food security. A total of 235 pregnant women participated in the study. The prevalence of food insecurity among pregnant women household was 41.3%; consisting of, in categories of severity, 32.3% household food insecure, 0.9% individual food insecure and 8.1% child hunger. The mean gestational weight gain of the participants was 8.8 kg (SD 5.05). This study found that food insecurity was significantly associated ($\chi 2$= 10.98, p= 0.004) with gestational weight gain. The Multiple Logistic Regression, with excessive pregnancy weight gain as outcome, showed pregnant women who had food insecurity were 4.8 times (adjOR 4.80, 95% CI: 1.94, 11.86; *p*=0.001) more likely to have excessive gestational weight gain compared to the food secured pregnant women. Being overweight and obese at pre-

pregnancy was at higher odds (adjOR6.17, 95%CI: 2.70, 14.09; p<0.001) of excessive gestational weight gain compared to women with normal body mass index prior to pregnancy. The study found that there were significant association between food insecurity and high pre-pregnancy body mass index with gestational weight gain in the antenatal clinic, Hospital Universiti Sains Malaysia, Kota Bharu. Therefore, there is a need to ensure adequacy of food and nutrients among pregnant women.

Keywords: food insecurity, pregnant women, gestational weight gain, body mass index.

CHAPTER ONE

1. INTRODUCTION

1.1 Study background

Food security is defined as "*when one is able, physically or financially, to access safe and nutritious food according to his daily needs for a healthy life*" (FAO, 1996). The inability to attain this aspect is known as food insecurity. Even if the availability is only limited and uncertain, it is considered food insecurity (Laraia *et al.*, 2010). Food insecurity has been recognised as a worldwide problem that requires multinational efforts towards decreasing its effects on many levels: individual, household, society and national. It is mostly due to financial rather than physical limitations.

The Rome Declaration on World Food Security identified poverty as the major cause of food insecurity (FAO, 1996). Low-income households generally have limited financial resources or do not have the means to buy good nutritious food for the family. To worsen the matter, the rapid increase in inflation, especially on the price of food and other essential goods, exacerbates poverty. Food insecurity affects both rural and urban communities. Poverty (FAO, 1996) and low income (Laraia *et al.*, 2010; Radimer *et al.*, 1992) has been one of the main factor associated with food insecurity. Other associating factors include household size, single parent, minority race and low education status (Gundersen, 2013; Laraia *et al.*, 2010). But Ihabi *et al.* (2013) found that single parent was not associated with food insecurity in a study in rural Kelantan as most of the single parents were women who were also the main breadwinner of the family, before and after

the change of their marital status.

Nevertheless, special attention needs to be given to women with regards to the effects of food insecurity. Association has been found between food insecurity and obesity, eating disorders and depressive symptoms (Ivers and Cullen, 2011; Laraia *et al.*, 2006; Olson and Strawderman, 2008). In almost all society, women have multiple roles as the caregivers; child bearer, and even the breadwinner. A mother will usually put the needs of her children first thus compromising her own dietary needs (Ali Naser *et al.*, 2014; Martin and Lippert, 2012). As a result, food insecurity is associated with negative pregnancy outcomes such as low birth weight babies (Ali Naser *et al.*, 2014; Ivers and Cullen, 2011).

The Barker's Hypothesis suggested that nutritional status of women during pregnancy might influence the birth weight of their offspring. Using data from a historical cohort, David Barker showed that infants with low birth weight have higher risks of developing cardiovascular diseases compared to those with normal birth weight. This may be due to insults during plastic periods of foetal development causing organ or system defect. These insults could also results in later life higher risk of chronic diseases such as chronic heart disease, diabetes mellitus, stroke and hypertension (Barker, 2003). David Barker's Hypothesis has been controversial but at the same time influential in setting research agenda relating to nutrition in pregnant women (Wadhwa *et al.*, 2009).

The Economic Planning Unit of the Prime Minister's Department of Malaysia, using data from Department of Statistic Malaysia survey, has defined two categories of poverty by looking at the monthly financial gain of each household. They are those who

are in ‘poverty’ and ‘hardcore poverty’. In the year 2012, the households in poverty are those who had income of less than RM830 per month, whereas the households in hardcore poverty are those whose incomes were less than RM 520 per month. The incomes per capita for the two categories are less than RM210 and RM130 respectively. The incidences of poor and hardcore poor household in the state of Kelantan were 2.7% and 0.3% during the year 2012. Kelantan had the second highest incidence of poverty according to this statistic (EPU Malaysia, 2014). Hospital Universiti Sains Malaysia in Kota Bharu is the referring centre to the nearby districts in Kelantan. It provides opportunity for a study to delve into the association of food insecurity and pregnancy weight gain.

1.2 Rationale of the study

Although there have been studies on nutrition status of pregnant women with their pregnancy outcomes, food security during pregnancy has not been studied well. In a developing country like Malaysia, where it is undergoing a nutritional transition, food insecurity may not be a pressing issue but at the same time, not to be overlooked. An assessment at the local hospital setting may perhaps be the first step toward providing a better service to the public, more specifically to the food insecure group including pregnant women. The pregnant women’s health may affect the health of future generations. However, there is currently no evidence to show if there is food security issue among pregnant women in Malaysia. Therefore, there is a need to fill such gap for the benefit of future use.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Food Insecurity and sociodemographic

Food security in a household was found to be greatly dependent on the resources available within the household (Campbell, 1991). The three main resources would be men, money and materials. But, a hypothesized concept by Campbell (1991) regarding food insecurity and its risk factors had included time, information and health alongside with money as major household resources. Time to access food and information on food would guide the household in acquiring good food supply, both nutritious and adequate. Without good health, income earners might not be able earn money from their jobs to buy food. Restrictions of food supply on either the household or individuals within the household would affect the quality of life and health.

Radimer *et al.* (1990) had categorised food insecurity status into three categories, which were household food insecurity, individual food insecurity and child hunger. Household food insecurity was referred to the uncertainty of food availability leading to anxiety, depletion of the food supply and inability to buy appropriate and good food or inability to obtained food within a socially acceptable ways. Individual food insecurity would refer to insufficient intake, inadequate diet intake and uncertainty of getting adequate daily meals. Children are usually protected from food insecurity as adults, mainly women, protected them. Child hunger was the last category described by Radimer *et al.* (1990)

Poverty was identified as a major cause of food insecurity. Total monthly income and income per capita within a household were the major indicators for poverty status (EPU Malaysia, 2014). Income per capita was directly related to total income and number of household occupants. A local study in Kelantan has shown significant association between number of household occupants and income per capita with food insecurity (Ali Naser *et al.*, 2014). This has also been observed in many countries such as Ethiopia (Birhane *et al.*, 2014), United States of America (Hromi-Fiedler *et al.*, 2011; Rose, 1999) and Canada (Tarasuk, 2001).

Any household that experiences poverty may have to go through more hardships compared to other fortunate households. Braveman *et al.* (2010) in a study looking at several aspects of hardships among pregnant women with poverty noted that food insecurity was one of the many hardships that the poor and near-poor groups of pregnant women had to go through. Being in the stressful conditions during these vulnerable pregnancy period and critical foetal development period, the hardships that came about from poverty may have adverse health effects. However Braveman *et al.* (2010) did not study the associations between hardship and health effects, which can potentially have implications across the life course of either the mother or even the child.

Poverty can affect the population regardless of rural or urban area. Food insecurity in rural area was directly associated with the financial status of a household. However, in an underdeveloped country such as Ethiopia, the impact of food insecurity could be precluded during harvesting periods of agriculturally dependent households. This was due to higher availability of food during such time. Irrespective of harvesting

periods, urban area households would have to endure food insecurity because of their total dependency towards market driven food supply with fluctuating price range, which could be worsened by low household income (Birhane *et al.*, 2014). This urban food insecurity was not only applicable to the under-developed countries but also developed countries as the food availability and accessibility depends on market prices. Food insecurity had been studied in the cities of developed countries such as France and Australia. In Paris, food insecurity was seen in all level of socio-occupational groups. Food insecurity was more prevalent in the lower socioeconomic groups with minimum income such as lower white-collar workers, blue-collar workers and the unemployed with social assistance or benefits (Martin-Fernandez *et al.*, 2013). Similarly in Brisbane, the lower-income group had significantly higher odds of experiencing food insecurity compared to the middle-income group with reference to higher-income group. The lower income groups were 8 times more likely of having food insecurity compared to the highest tertile of income groups. It can be predicted to worsen with food and financial crisis situation (Ramsey *et al.*, 2012).

In the urban areas, relative poverty becomes a greater issue. Gundersen (2013) had observed that a developed country, such as the United States of America, which had strong economic conditions in the years 2001 to 2010, its food insecurity rates had never fall below 10%. The study found that households, whose income was below the United States of America poverty line, were able to experience food security. In contrast, there were households with income above poverty line but suffered with food insecurity. The study also indicated that poverty was not synonymous with food insecurity but became a major contributor. Poor financial management skills have been identified as the main

problem in such households.

The head of the household plays an important role in decision-making and financial management for the household. The level of education attainment of the head of the household is of significant in managing food security within the household. Birhane *et al.* (2014) showed that head of the household's low education was significantly associated with food insecurity. Low educational attainment of women in the household, who manages the food preparation and production, has been found to be one of the determinants of food insecurity. Laraia *et al.* (2013) revealed that food insecurity is more likely to occur in women with the least average educational years, even though they had a mean of 13.9 years of education. Similarly to this study, Shariff and Khor (2005) found that low education was significantly associated to food insecurity in Malaysia. Malaysian women with 7.8 and 6.3 mean years of educations were reported to have household food insecurity and child hunger in her household, respectively. Low education attainment is associated with food insecurity in both developed and developing countries.

However, Shariff and Khor (2008) later observed that food security status improved if women were the breadwinner of the family. The chance to socialize in a working environment and the prospect of earning money for the family gave the women more influence in household decision making. Along with the autonomy, women who were the main wage-earner might have better education attainment and social capital, which in return further support better food security status (Walker *et al.*, 2007).

In most societies, women were usually the one who manages hunger from food

insecurity at individual or household levels, regardless if their households were above or below the poverty line (Radimer *et al.*, 1992). The capacity to make decision in the household allowed them to manage the main aspects of food insecurity; which are food quantity, food quality, food acceptability and certainty of getting food.

Regardless of how much educational attainment a mother received, mothers even with mean year of schooling was 5.8 (SD 3.9) had been found to adopt different strategies in coping with food insecurity (Norhasmah *et al.*, 2010). The strategies involved both the basic daily food-related and non-food related component. The strategies included food rationing, food stretching and food seeking circumstances. Nonetheless, a mother will usually put the needs of her children first thus compromising her own dietary needs. Norhasmah *et al.* (2010) had found that mothers would purchase less expensive and preferred food to cut cost. They would rather eat leftovers or skip meals to prioritize their children's need.

A randomized control trial was conducted in New Zealand to evaluate the effect of money provision for 4 weeks among women from the food-insecure households. Women participated in this study, as they were mainly responsible for food preparation. The study showed that providing money, as a relief for food insecure group, would not change the purchasing behaviour. But, the expense on food increased with the provision especially on staple food, such as potatoes and kumara, or calories-rich food. Healthier food was bought only if discounted price and yet, there were no decrease on purchases of non-healthier options. Despite easing the impact of food insecurity, the study did not show the impact on food insecurity status of the household and nutritional inequalities

(Smith *et al.*, 2013).

The high consumption of staple and calories-rich food were seen in a study in the United States of America (Martin and Lippert, 2012). A mother would consume high energy-laden food for herself and leave the best nutritious food to her children. This ensures a high-energy diet for the mother but may compromise her micronutrient intakes such as calcium, iron, zinc, magnesium or vitamins. This might lead to health issues among these women, including pregnant mothers, with food insecurity problems. McIntyre *et al.* (2003) and Sim *et al.* (2011) found that single headed women would compromise their dietary intake to provide the necessary needs of their children. In order to cope with food insecurity, food management behaviours of these mothers were either authoritative, healthism or planning in gaining or purchasing food supply. Being authoritative means that the women become a decision maker in menu planning and eating behaviour of their family. Healthism referred to when the healthy eating practised in households. Planning on the menu for days in advance allowed the women to make better purchase of food for their household. These management behaviours could be guided to improve diet quality (Sim *et al.*, 2011).

Poverty can affect the child development *in utero* development if the mother was undernourished. This can be the case in food insecurity. This may lead to intrauterine growth restriction, which later presents as low birthweight (Chilton *et al.*, 2007). Low birthweight has been associated with the development of chronic diseases in later life such as diabetic and coronary heart disease (Barker, 2004).

2.2 Food insecurity and women's health

Traditionally, women are the caregiver and the child bearer in most societies. These responsibilities, in addition to a large household size and low income, may have an impact on their mental and physical health. Research has shown that women with these problems were more susceptible to an undiagnosed depression especially in the rural setting. These women were also more likely not to seek help, in addition to the unavailability of professional help even when they do seek help, and the stigmatisation by the community, which further worsen the situation. Food insecurity was also associated with low self-esteem and anxiety in women especially among those with low education and poor coping strategies (Laraia *et al.*, 2006). Depressive symptoms were associated with risk for both marginal food security and food insecurity (Laraia *et al.*, 2009).

It has been shown that there was significant association in maternal depression and food insecurity (Dewing *et al.*, 2013; Garg *et al.*, 2014; Huddleston-Casas *et al.*, 2008) Lack of education also contribute to progressive depressive symptoms. Women, with low education attainment and those in rural areas with conservative opinion of mental health, would not take up mental health services (Huddleston-Casas *et al.*, 2008). If food insecurity was not resolved, it might be associated with postpartum depression, harmful drinking and even suicide (Dewing *et al.*, 2013).

Obesity had been regularly implicated from excessive eating, but food insecurity has also been associated with obesity in women (Ivers and Cullen, 2011). There were

several reasons to explain the increase in body mass index. Women, as main caregivers, are responsible for food preparation in the household. Women from low-income households will spend less on quality food but more on the best attainable quantity of food. The food consumed was high energy dense and palatable, mostly carbohydrate-based food or content of high volume of water, which leads to early satiety. In western countries, potato chips, cookies, doughnuts and pizza were preferred and low calories food such as fruits and vegetables were less consumed (Drewnowski and Specter, 2004). Townsend *et al.* (2001) has showed that the mild and moderate food insecure groups had higher prevalence of overweight compared to the severely food insecure and food secure groups. The study showed food insecurity was significantly and independently associated with overweight status in women.

Another explanation for an increase in BMI is the prevalence of binge eating among food insecure women. Food availability will lead to binge eating among women from food insecure household. It is due to their worry over the shortage of food in the near future. Some families in the United States of America were found to finish their allocated food supply from food stamp before the recommended period, thus creating a short period of no food supply (Castillo *et al.*, 2012). Townsend *et al.* (2001) also hypothesised a “food stamp cycle” whereby in a month cycle of food stamps, the food-insecure family would overeating the abundant of food supplies in the first 3 weeks followed by an involuntary period of limited food prior getting food stamps for the coming month. Based on this cycle, women turned to prioritize her children. Such cycle of weight gain and weight loss could lead to overweight and obesity in women over time.

The dynamics of food insecurity and obesity in women had produced mix conclusions in different studies. Jones and Frongillo (2007) found no strong association between food insecurity with subsequent weight gain over a period of 2 years among women in the US. Even after controlling for covariates, the association were not significantly changed. Modest association of food insecurity and weight gain was found among women who had given birth during the study period. Olson and Strawderman (2008) found that weight gain of childbearing women in food insecure family was strongly associated with obesity in early pregnancy. However food insecurity at early pregnancy was not significantly associated with obesity at 2 years postpartum. Instead there was a significant association between obesity in early pregnancy with risk of food insecurity at 2 years postpartum.

Very low food security had significant association with higher BMI after controlling for confounders was shown among urban population in Paris (Martin-Fernandez *et al.*, 2014). However, studies in Malaysia and Iran showed no relationships between food insecurity and obesity, but significant association with central obesity or increase waist circumference (Mohammadi *et al.*, 2013; Shariff and Khor, 2005). Severe food insecure household in Iran were found to be significantly associated with central obesity. Similarly in Malaysia, women of food insecure household associated with central obesity due to their higher time in domestic and leisure activities compared to women of food secure household.

Another scenario occurred from food insecurity is dual form malnutrition, which is overweight women and underweight children in the same household. Dual burden

malnutrition was part of the nutrition transition in developing countries due to mechanisation, sedentary lifestyle of some population and availability of fast food or processed food. Mechanisation means that the labour or daily work of a person is being replace by machineries or mechanical technologies (Gopalan, 2013). The dual form of malnutrition has been shown to occur among poor household in Malaysia (Khor and Sharif, 2003). Although the food security status was not established in the study, poverty had been implicated with food insecurity. Ihab *et al.* (2013) had further supported the findings in a different population in Kelantan, Malaysia. There was a significant association between single headed household and dual burden malnutrition. The dynamic of food insecurity and dual burden malnutrition remained a challenge as treating single form of them, either food insecurity or double burden malnutrition, might worsen the other side.

Studies have found that food insecurity was also associated with increased waist circumference and obesity. Obesity was found to be associated with coronary heart disease, hypertension, diabetes mellitus and cancers. In Malaysia, a study among plantations workers showed that there was an association between food insecurity with increase body mass index and central adiposity. Central adiposity, measured at waist circumference, was indirectly associated other health risk such as diabetes mellitus, hypertension and cardiovascular diseases (Mohamadpour *et al.*, 2012). The pathway between food insecurity and diabetes involved obesity as mediating factor for diabetes mellitus. It had been found that food insecurity was significantly related with diabetes mellitus (Fitzgerald *et al.*, 2011).

Laraia (2013) had postulated a conceptual framework that showed the association between household food insecurity and weight gain leads to chronic diseases and other complications. Nevertheless, when arguing about women's health in food insecurity status, the influences of food insecurity on pregnancy cannot be overlooked.

2.3 Food insecurity and pregnancy

Food insecurity might have long-term consequences on maternal and child health. Pregnant women require higher nutritional intake to support foetal development and the women's own well-being. As the pregnancies progress, the women's role in preparing and producing food for the households become more challenging thus increasing hardship. Food insecurity and these challenges may lead to mental health issues, such as stress and anxiety (Laraia *et al.*, 2006).

Micronutrient deficiencies are also associated with pregnant women in food insecure households. Zinc deficiency had been linked to prenatal complications as well as adverse foetal and maternal outcomes (Shah and Sachdev, 2001). In a cross sectional study in Ethiopia, risk of Zinc deficiency was significantly associated with food insecurity. The study showed that there was a strong correlation between food insecurity and risk of zinc deficiency. The study had also found that higher maternal education might have been a factor to a higher zinc status in pregnant mothers due to compliancy to supplementation and nutritional intake (Gebremedhin *et al.*, 2011).

The commonest micronutrients deficiency is iron deficiency in pregnancy. Iron deficiency can lead to iron deficiency anaemia. Iron deficiency anaemia during the first two trimesters of pregnancy is associated with a two-fold increased risk of preterm

delivery and a three-fold increased risk of having a low-birthweight baby (CDC, 1998). A study done in USA showed that iron intake was significantly higher in food secured pregnant women compared to food insecure counterparts. But interestingly, the differences were due to the fact that the better food security groups had better supplementation intake of iron compared to the food insecure group. The dietary iron intake was not associated with food security status (Park and Eicher-Miller, 2014).

Food insecurity is also associated with overweight and obesity in women including pregnant women (Drewnowski and Specter, 2004; Laraia *et al.*, 2010). Laraia *et al.* (2010) showed that one in 10 pregnant women were identified to have food insecurity issue. The finding also showed an association between food insecurity and higher body mass index during pregnancy. However, there was insignificant association between food insecurity and excessive gestational weight gain ratio. However, low income had been showed to have significant association with excessive gestational weight gain (Deierlein *et al.*, 2008; Olson and Strawderman, 2003). Women with higher body mass index prior pregnancy were also at higher risk of excessive gestational weight gain (Bogaerts *et al.*, 2012; Hernandez, 2012; Olson and Strawderman, 2003) and developing gestational diabetes mellitus (Laraia *et al.*, 2010; Olson, 2010). Gestational diabetes mellitus is a known risk factor for macrosomia. A Canadian longitudinal study showed that infants born in food insecure households, either higher or lower than expected normal birth weight, were more likely to developed childhood obesity (Castillo *et al.*, 2012).

2.4 Conceptual framework

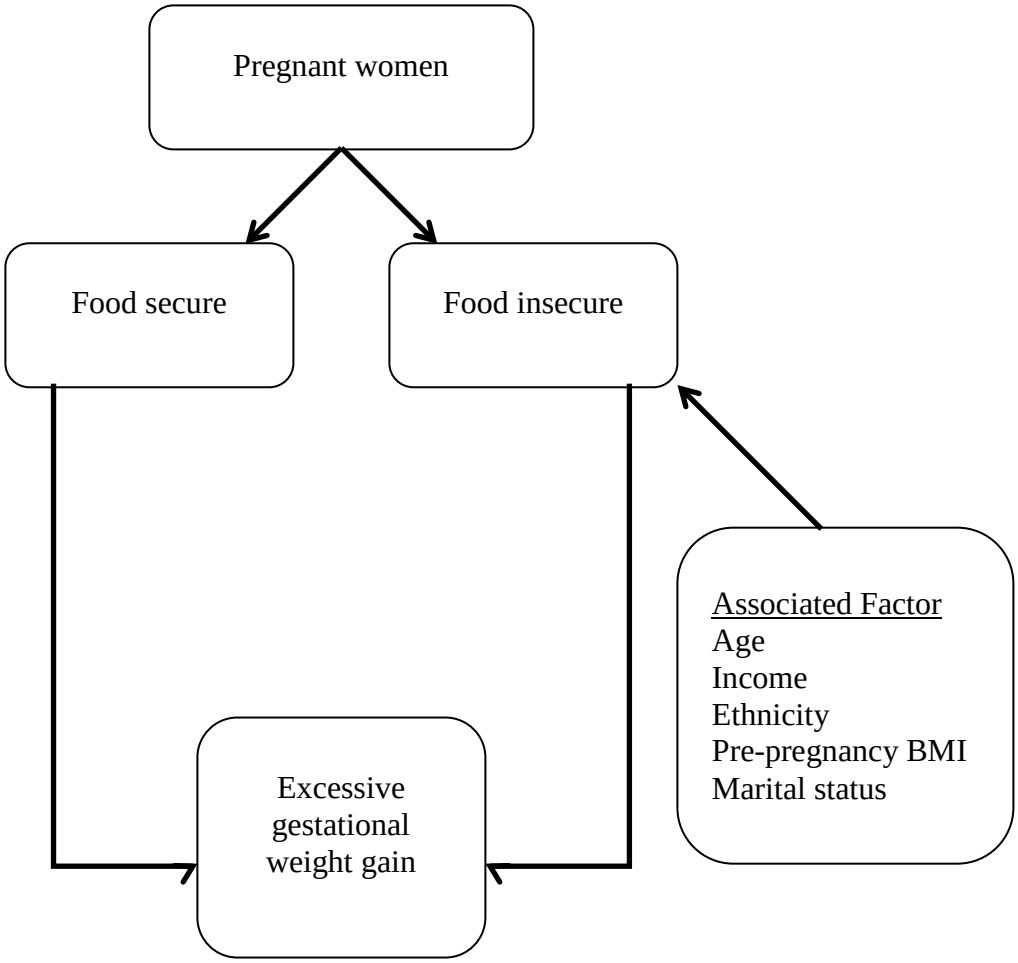

Figure 3.1: Conceptual Framework

The conceptual framework in Figure 3.1 showed that the household food insecure pregnant women among those attending antenatal clinic Hospital Universiti Sains Malaysia were identified. The association between household food insecurity and gestational weight gain were determined. The factors associated were assessed in predicting the gestational weight gain with food insecurity as a mediating factor and independent factor itself.

CHAPTER THREE

3. OBJECTIVES

3.1 General objectives

To assess gestational weight gain and its associated factors, specifically food security, among pregnant women attending antenatal clinics in Hospital Universiti Sains Malaysia.

3.2 Specific objectives:

1) To identify gestational weight gain status among pregnant women attending antenatal clinic in Hospital Universiti Sains Malaysia.
2) To determine the association between household food insecurity status with gestational weight gain among pregnant women attending antenatal clinic Hospital Universiti Sains Malaysia.
3) To assess the factors associated, including household food insecurity status, with gestational weight gain among women attending antenatal clinics in Hospital Universiti Sains Malaysia.

3.3 Research hypothesis

H_o: There is no association between excessive gestational weight gain with household food insecurity among pregnant women attending antenatal clinics in Hospital Universiti Sains Malaysia.

CHAPTER FOUR

4. METHODOLOGY

4.1 Study design

This study was a cross-sectional study.

4.2 Study location

Antenatal clinic of Hospital Universiti Sains Malaysia

4.3 Study period

Pregnant women who attended the antenatal clinics, HUSM between 8th February 2015 and 2nd April 2015 were selected to undertake the interview done in the same clinics.

4.4 Reference population

All pregnant women in Kota Bharu district.

4.5 Source of population

All pregnant women, in their second or third trimester of pregnancy, who attended the antenatal clinic at Hospital Universiti Sains Malaysia.

4.6 Sampling frame

Pregnant women attended the antenatal clinic, Hospital Universiti Sains Malaysia between 8th February 2015 and 2nd April 2015 who fulfilled the inclusion and exclusion criteria.

4.7 Study criteria

1. Inclusion criteria

   Pregnant mother with at least one child in the household (the youngest child < 12 years old)

2. Exclusion criteria

   Multiple pregnancy mothers who attended the antenatal clinic, Hospital Universiti Sains Malaysia

4.8 Sample size determination

The sample size was calculated according to the study objectives.

1) Objective 1

Objective 1 was to identify household food insecurity status among pregnant women attending antenatal clinic in Hospital Universiti Sains Malaysia. The sample was calculated using single proportion formula:

Equation 4.1: Single proportion sample size estimation formula

$$n = \left(\frac{Z_{\propto}}{\Delta}\right)^2 \times P\ (1 - P)$$

P = expected proportion of the sample with the characteristic of interest
Z_{α} = Z value based on 95% Confidence interval or normal deviates that reflects Type I error
Δ = precision or detectable deviation

In Laraia *et al.* (2010), it was found that 10% of the study sample was food insecure. Thus, the calculation was:

$$n = \left(\frac{1.96}{0.05}\right)^2 \times 0.1\,(1 - 0.1)$$

$$n = (39.2)^2 \times 0.09$$

$$n = 138$$

Sample size calculated was 138 subjects. Allowing for an expected 10% non-response rate, it was expected that an estimated total of 152 subjects would be recruited.

2) Objective 2

Objective 2 was to determine the association between food insecurity status and gestational weight gain among pregnant women attending antenatal clinic Hospital Universiti Sains Malaysia. Considering the gestational weight gain as an outcome and the household food insecurity as an independent variable, the calculation of sample size was performed by using PS software Version 3.

Table 4.1: Sample size estimation using gestational weight gain as variable

	P_0 (Adequate gestational weight gain)	P_1 (Excessive gestational weight gain)	μ	α	Power	n +20%	Literature Review
Food Insecure	0.10	0.71	1	0.05	80%	29	(Laraia *et al.*, 2010)

P_0 = Proportion of women with adequate gestational weight gain as control
P_1 = Proportion of women with excessive gestational weight gain as expected
μ = Ratio of adequate gestational weight gain to excessive gestational weight gain
α = Type I error
n = Number of sample

The number of sample estimated for objective 2 was 29.

4) Objective 3

Objective 3 was to assess the associated factors between food insecurity status with weight gain during pregnancy and anaemia in an antenatal clinic Hospital Universiti Sains Malaysia.

The associated factors assessed include education, income and number of children. Sample size for the numerical associated factors was estimated by the PS software Version 3 to compare two means, standard deviation, detectable difference at 80% power and $\alpha = 0.05$. The estimated sample sizes were shown in the table below.

Table 4.2: Sample size estimations comparing two means of variables

	α	Power	μ	σ	δ	N +10%
Education*	0.05	80%	1	2.5	1.3	130
Income*	0.05	80%	1	91.4	98.5	33
No. of Children*	0.05	80%	1	1.3	0.5	235

*(Laraia *et al.*, 2010)
μ = ratio of food secure to food insecure sample
σ = within group standard deviation
δ = a difference in population means

The maximum number from the calculations was 235.

As a conclusion, the estimation for the variable of 'number of children' in this sample size calculation was chosen as the sample size for this study as it was the maximum number calculated. The total sample of mothers recruited would be 235.

4.9 Sampling method

All pregnant women who attended the antenatal clinic Hospital Universiti Sains

Malaysia and met the inclusion or exclusion criteria were invited to participate. Thus, a whole source population sampling method was used for this study.

4.10 Research tools and materials

a) The study questionnaire consisted of sections as described:

A. Demography and socioeconomic variables; consisted of age, ethnicity, maternal education, household incomes, and number of household members

B. Maternal medical and obstetrics history; including previous medical history, previous number of pregnancies, previous miscarriages and stillbirths, previous pregnancy-associated medical conditions, current pre-pregnancy weight, height, current pregnancy weight and weight gain during pregnancy, and haemogloblin level during first visit.

C. Validated malay version of the Radimer/Cornell Hunger and Food Insecurity Instrument. This instrument has been validated by Sharif and Ang (2001). This instrument was originally developed by Radimer *et al.* (1990) through qualitative interviews of women with children at home. Two broad concepts emerged from the interviews. The narrow concept was on inadequate food intake and persistence of hunger due to lack of food. The broader concept includes food supply problems, quality of diets, feeling of the circumstances and effort in trying to maintain household food supply. Radimer *et al.* (1992) identified four components of food insecurity including quantitative, qualitative, psychological and social. All four components can be assessed at household and individual level. Although the original instrument was developed and tested on women

from lower socioeconomic households, further work by Kendall *et al.* (1995) supported its use on more diverse households.

b) Antenatal record of participants at antenatal clinic, Hospital Universiti Sains Malaysia

c) Ministry of Health's antenatal record book (KIK/1(a)/96 Pindaan 2012)

4.11 Data collection

A total of 235 pregnant women were recruited in this study. Data collection was carried out by the author and a trained research assistant. The validated questionnaire was administered to every participant within 10 to 15 minutes.

Prior to the study, participants were also asked for consent to access their medical records. The purpose of accessing the medical records was to complete the questionnaire on any missing variables, especially Section B of the questionnaire.

4.12 Operational definition:

a) Radimer/Cornell Household Food Security Status

Food Insecure:

1) Household Food insecure – Food-related uncertainty and anxiety at household level
2) Individual Food Insecure – a decrease in the quality and quantity of food consumed by adult

3) Child hunger – a decrease in the quality and quantity of food consumed by a child

Food secure – Food obtained on acceptable quantity and quality

b) Category of Household Food Security Status according to responses to Radimer/Cornell Hunger and Food Insecurity Instrument adapted from Shariff *et al.* (2014)

Table 4.3: Categories of Food Security Status and responses to Radimer / Cornell Hunger and Food Insecurity Instrument*

Category	Responses to Radimer/Cornell Hunger and Food Insecurity instrument Questions
Food Secure	Negative answers to all Question (Q1-10)
Food Insecure	
Household Food Insecure	≥ 1 Positive answer to Question 1 to 4; Negative answers to Question 5 – 10
Individual Food Insecure	≥ 1 Positive answer to Question 5 – 8 ; Negative answers to Question 9 & 10
Child Hunger	Positive answers to Question 9 & 10

*adapted from Shariff *et al.* (2014)

c) Household

According to Department of Statistics Malaysia (2010), a household comprise of individuals, related and/or unrelated, who usually live together and mutually make provisions for food and other basic necessary needs of living from a single resource or pooled resources.